APPENDIX G: BEST MANAGEMENT PRACTICES

1.01 INTRODUCTION

This appendix is meant to add further clarification and definition of what each BMP practice mentioned in the watershed plan is. It is intended to be general in nature to provide that context, but does not include information on pollutant removal or treatment efficiencies or rates, as those values can vary widely based on many factors. Information on those values is included in the water quality modeling report for BMPs that were used in the water quality modeling effort.

1.02 CROPLAND PRACTICES

FILTER/BUFFER STRIP

Grass filter strips, or vegetated buffers, are planted between surface waters and fields to protect water quality. The use of vegetated buffers along streams, and vegetated filter strips in uplands can provide significant reductions of nutrients, sediment and pathogens to waterbodies. Pollutant removal rates largely depend on buffer width, vegetative make up and pollutant type. Various standards exist for buffer width recommendations for both water quality maintenance and basic habitat as this number may be modified based on other factors such as slope, soil type, adjacent land use, the presence of certain wildlife communities, stream size, and stream order.

CONTOUR FARMING

Contour farming is growing crops perpendicular to a field slope, rather than up and down, with each row generally following the same elevation across the field. This practice reduces soil erosion and facilitates equipment and other farming or conservation practices.

INTEGRATED PEST MANAGEMENT

This is a site-specific combination of pest prevention, pest avoidance, pest monitoring, and pest suppression strategies. Typically, a comprehensive plan is developed to meet the following purposes:

1. Prevent or mitigate off-site pesticide risks to water quality from leaching, solution runoff and adsorbed runoff losses.
2. Prevent or mitigate off-site pesticide risks to soil, water, air, plants, animals and humans from drift and volatilization losses.
3. Prevent or mitigate on-site pesticide risks to pollinators and other beneficial species through direct contact.
4. Prevent or mitigate cultural, mechanical and biological pest suppression risks to soil, water, air, plants, animals and humans

UNDERGROUND OUTLET/ GRASS WATERWAY

Underground outlets consist of using tiling or other conduit, or system of conduits, installed beneath the surface of the ground to convey surface water to a suitable outlet. This carry water to a suitable outlet from terraces, water and sediment control basins, diversions, waterways, surface drains, other similar practices or flow concentrations without causing damage by erosion or flooding. Conversly a grass waterway function similarly to avoid erosion; however, a grass waterway uses a shaped or graded channel that is established with suitable vegetation to carry surface water at a nonerosive velocity to a stable outlet.

CROP TO GRASS/ HABITAT/ CRP CONVERSION

This is also known as cropland conversion or land retirement, and consists of converting cropland to perennial grassland cover. This is often through existing government retirement programs such as CRP. Significant environmental gains can be achieved by permanently converting row crop back into grass. Crop ground to grass conversions are considered by producers for multiple reasons including economic gains, wildlife enhancement, and pastureland establishment.

IRRIGATION MANAGEMENT

This practices consists of determining and controlling the volume, frequency, and application rate of irrigation water. This allows improved water use efficiency (both groundwater and surface water), minimizes soil erosion, and reduces the amount of pollutants that are leached into groundwater or carried to surface waters. A variety of techniques and technologies are utilized, including variable rate irrigation, soil moisture monitoring, weather monitoring, irrigation system improvements, changes in crop type, and other methods.

NO-TILL

This BMP involves managing the amount of crop and plan residue on the soil surface year round, primarily through limiting tillage or plowing activities which disturb and expose the soil. Leaving plan residue on the soil surface protects from erosion and improves soil organic matter over time.

SOIL SAMPLING

Soil testing can be considered the basis for all nutrient management plans and should be practiced regularly by all producers. As commodity prices drop, managing input costs becomes an increasing concern to producers, making nutrient management even more important. Soil sampling is a practice that may save a producer a considerable amount of money by reducing fertilizer inputs, yet maintaining a strong yield, without economic incentives to encourage implementation.

TERRACES/DIVERSIONS

Terraces consist of an earthen embankment, channel, or a combined ridge and channel built across the slope of the field. They may reduce the sediment load and content of associated pollutants in surface water runoff. Terraces intercept and store surface runoff, trapping sediments and pollutants. In some types of terraces, underground drainage outlets are used to collect soluble nutrient and pesticide leachates, reducing the risk of movement of pollutants into the groundwater, and improving field drainage. However, the waterbody receiving runoff directly via tile drains can be impacted by high pesticide and dissolved nutrient concentrations, as well as a change in the hydrology of the stream network.

A diversion is very similar to a terrace, but its purpose is to direct or divert surface water runoff away from an area, or to collect and direct water to a pond. Filter strips should be installed above the diversion channel to trap sediment and protect the diversion. Similarly, vegetative cover should be maintained in the diversion ridge. Any associated outlets should be kept clear of debris.

RETENTION BASIN

Retention basins are also referred to as wet ponds or farm ponds, and they hold back water. The retention pond has a permanent pool of water that fluctuates in response to precipitation and runoff from the contributing areas. Maintaining a pool discourages re-suspension of sediments and keeps deposited sediments at the bottom of the holding area. Natural attenuation of pollutants, especially nutrients and bacteria, is a key benefit to retention facilities. Renovation of existing structures is also a practice and can be a more cost effective practice than constructing a new pond.

DETENTION BASIN

Detention ponds are similar to retention basins, but do not permanently hold water, and can serve as infiltration or bioretention features. They are designed to remain dry except during or after rain or snow melt, which allows for agricultural use to continue on a regular basis above the structure. Their purpose is to slow down water flow and hold it for a short period of time to allow natural treatment of pollutants.

SEDIMENT CONTROL BASIN

Sediment control basins can be used to collect, trap, and store sediment produced by agricultural or urban activities, or serve as flow detention facility. Sediment traps are much smaller than a retention or detention basin. A sediment control basin is constructed by excavation or by placing an earthen embankment across a low area or drainage swale. They may include a riser and pipe outlet with a small spillway.

1.03 NON-PERMITTED LIVESTOCK PRACTICES

ALTERNATE WATER SUPPLY

This BMP ensures that livestock have adequate access to clean drinking water away from streams, ponds, springs or wells. Used mainly with grazing systems, well-designed watering systems protect soil and water quality while improving livestock health and productivity. They reduce sediment and nutrient loading in streams and lakes by preventing bank and shore erosion and limiting the amount of livestock urine and feces deposited directly in the water. Watering system "hardware" typically includes permanent or portable watertight tanks or troughs with pipelines and pumps to move water from the water source to the tanks.

MANURE MANAGEMENT

Land application of animal manure helps to recycle nutrients in the soil and adds organic matter to improve soil structure, tilth, and water holding capacity. One major concern about this practice is that unintended runoff to surface water and buildup of phosphorus in soils results in nutrient delivery to downstream water resources, therefor soil sampling as part of a nutrient management is recommended to be completed with this practices. Manure management includes methods such as applying manure at agronomic rates, using methods that limit runoff (such as knifing) and applying manure outside of priority area subwatersheds.

Additionally, this practice also includes activities to limit the exposure of manure to precipitation, particularly at non-permitted AFO facilities. This is usually in manure storage areas or heavy use areas such as barnyards, stables, wintering areas, and open lots. Usually these practices include clean water embankment diversions, runoff capture and detainment, vegetated treatment of runoff, installation of concrete and curbs to facilitate clean out, and installing a structure with a roof and gutter to collect precipitation and divert it from the site.

REDUCED NUTRIENTS IN FEED

Geographic areas with intense livestock production often import more nutrients in the form of feed than is exported in livestock or crop products. When manure is applied intensely to these areas over long periods of time, phosphorus tends to increase in the soils unless the manure is exported. Phosphorus inputs not only include the natural content of feed, but mineral supplements. Careful balancing of livestock rations may allow reductions in added phosphorus, thereby reducing the phosphorus content of manure. Providing education to producers to promote feed ration optimization as a means to improve profits is a key component to this practice.

PASTURE MANAGEMENT/PRESCRIBED GRAZING

Allowing cattle to overgraze pastures and especially along streams can also lead to stress on pasture and excessive erosion initiated by hoof damage to stream banks. Grazing management consists of developing a plan to maintain vegetative cover usually based on stocking rates, fencing livestock into smaller paddocks to allow for rotational grazing, fencing livestock from sensitive areas such as streambanks, and providing alternative water sources to help distribute impacts from cattle.

EXCLUSION FENCING

Livestock find their own favorite areas to graze, drink, congregate, and rest within a riparian area. Without management, some areas will be overused and the resulting impacts will impair or destroy the riparian system. This practice includes installing fencing to restrict or eliminate livestock access to streams or other water bodies. This also requires a producer to provide an alternative water source to livestock. Key practice components include providing: off-stream watering, livestock comfort, streamside fencing, stream crossings, and buffer strips.

1.04 URBAN PRACTICES

PET WASTE ORDINANCES/ MANAGEMENT

Pet waste can contribute nutrients and bacteria to water bodies during precipitation events, particularly in urban areas with a high concentration of pets and limited natural areas to manage runoff. Encouraging communities to adopt ordinances requirement pet owners to clean up after their pets is an important first step in this practice. Education of pet owners, however, is critical to compliance with this practices.

POROUS PAVEMENT

Pervious pavement consists of a permeable surface course underlain by a uniformly-graded stone bed. This practices provides temporary storage of precipitation and helps to reduce peak flows during runoff events, promotes infiltration, and reduces runoff of nonpoint source pollution. The surface may consist of porous asphalt, porous concrete, or various porous structural pavers laid on uncompacted soil.

BIOSWALES

Bioswales are vegetated drainage courses designed to trap sediment and other pollutants from storm runoff. They are often installed as an alternative to underground storm sewers. The bioswale is engineered so runoff from frequent, small rains infiltrate into the soil below. When larger storms occur, bioswales slow the flow of runoff while using above ground vegetation to filter and clean the runoff before it ends up in a lake or stream. Bioswales can be good cost effective replacement for low-flow concrete liners in need of expensive repairs.

SOIL AMENDMENTS

Healthy soil is important to preventing runoff. Typically, as development occurs, top soil is removed and the remaining subsoil is compacted by grading and construction activity. The owner is left with heavily compacted subsoil, usually with high clay content and little organic matter. Soil quality restoration is simple - start by preserving top soil, reducing soil compaction, and increase organic matter content with the addition of compost. Soil quality restoration can be completed on any existing yard, making this one of the easiest and least expensive water quality conservation practices to implement.

RAIN GARDENS

Small-scale bioretention features, often referred to as 'rain gardens', are a structural conservation practice commonly used for stormwater quality improvement and reduction of stormwater runoff in urban areas. When properly designed and maintained, they can offer highly efficient reduction of phosphorus, as well as other pollutants, and are highly aesthetic.

RAIN WATER HARVESTING

Rain barrels are a very simple method for collecting roof runoff for beneficial uses such as irrigation of landscaping and gardens. Residential rain barrels typically hold 55 gallons and are connected to a downspout with a faucet and overflow pipe. Rain water is naturally soft, oxygenated, and free of chemicals that are used to treat most sources of publicly supplied water. This practices reduces runoff from residential areas.

LOW IMPACT LANDSCAPING

Native vegetation enhances a landscape's ability to manage stormwater, and also requires less water to survive. A diversified habitat with native vegetation encourages use by birds, butterflies, and other wildlife. In most cases, native vegetation doesn't require fertilizer or pesticides for survival. Native landscaping and turf can replace bluegrass and other non-native drought intolerant species commonly used in communities.

LOW OR NO-PHOSPHORUS FERTILIZERS

Nutrients are essential for plant growth, especially nitrogen, phosphorus, and potassium. Fertilizers, pesticides, and animal waste commonly include phosphorus. Excessive phosphorus loading is a leading contributor to algae growth, which lowers water quality and causes several issues in community lakes. No-phosphorus fertilizers (i.e. 30-0-3) are recommended to be used on established lawns, as most soils in Nebraska contain enough natural phosphorus to support a healthy lawn.

1.05 IN-STREAM OR RIPARIAN CORRIDOR PRACTICES

REMEANDERING

Many streams in Nebraska have been straightened for various landuse purposes; however, removing meanders and shortening the length of a waterway interferes with the natural functions of a stream and riparian system. A stream naturally tries to maintain a balance between sediment and water conveyance through flow rates and the natural length of the stream. When a stream is shortened is flows faster and becomes more erosive as it tries to regain that balance. Remeandering consists of mechanically restoring or building meanders back into the stream system to increase length and complexity of the stream channel. This decreases erosion and improves habitat and pollutant treatment capabilities.

OXBOW RECONNECTION

Reconneecting oxbows to a stream can be done on a permanent basis, similar to remeandering, or providing a connection to an existing oxbow during high flow events. This practice helps to reconnect the stream to the floodplain, increases the channel length, and provides additional habitat and water storage benefits. These features all help a stream to provide additional pollutant treatment capabilities.

FLOODPLAIN CONSTRUCTION/ RECONNECTION

Reconnecting a stream to its historic floodplain or bringing the floodplain back into contact with the stream is typically completed with earth moving equipment and is paired with streambank or grade stabilization practices or riparian area management, and may also include reconnecting a stream with old oxbow channels. This practice help to restore the natural hydrology of a stream system, improves aquatic habitat, and provides more opportunity for pollutant treatment during storm events.

STREAMBANK STABILIZATION

Streambank protection consists of restoring and protecting banks of streams and excavated channels against scour and erosion by using vegetative plantings, soil bioengineering, and structures. Eroding stream banks can be a major contributor of sediment and other pollutants to rivers, lakes, and streams. Due to straightening of streams, increased stream slope has occurred which increases the energy of the flow. This has caused the channel bed to incise resulting in bank failure and channel widening. Erosion occurs in many natural streams that have vegetated banks, however, land use changes or natural disturbances can cause the frequency and magnitude of water forces to increase. Loss of streamside vegetation leads to reduced resistance, making stream banks more susceptible to erosion.

GRADE CONTROL STRUCTURES

Grade control riffles spaced at regular intervals may help curb areas of minor incision in sections of streams by changing their profile from an erosive, steep incline to a stable stair-step pattern with hardened beds at each step. They allow stream elevation to drop in a controlled setting, while preventing further degradation.

IN-STREAM/CONSTRUCTED WETLANDS

In-stream wetlands can be created on small streams by impounding or adding a control structure to the stream, usually in smaller, lower order streams. Construction or restoration of created in-stream wetlands provides an opportunity to control nonpoint source pollution, regulate water storage, and provide habitat for both aquatic and non-aquatic species. A constructed wetland is an artificial wetland created for the purpose of treating runoff from an anthropogenic source, such as a livestock facility, urban runoff, or agricultural runoff. Designers use the natural processes involving wetland vegetation, soils, and hydrology to improve water quality. Constructed wetlands can enhance existing wetland systems or create a new system.

RIPARIAN ZONE RENOVATION

Riparian zone renovation includes improving the interface between land and a waterway through establishment of native vegetation. Riparian zones have been removed from many waterways affecting natural stream flow, accelerating stream bank erosion, and reducing pollutant filtration and infiltration. Structural alternatives may require stream bank reshaping, establishing native vegetation using live pole harvesting and planting, livestock exclusion fencing, and buffering.

1.06 IN-LAKE PRACTICES

SEDIMENT REMOVAL

Lake sediment removal is usually undertaken to deepen a lake and increase its volume to enhance fish production, to remove nutrient rich sediment, to remove toxic or hazardous material, or to reduce the abundance of rooted aquatic plants. The technique is recommended for deepening and for long range reduction of phosphorus release from sediment.

IN-LAKE FOREBAYS

Utilizing a portion of an existing reservoir, adding additional reservoir area above the existing reservoir, or a combination of both as a sediment/water quality basin is another means of minimizing the potential for materials to enter the main basin of a lake. Forebays, which serve as a trap for sediment and other pollutants, are commonly created at the headwaters of the reservoir to complement upstream conservation work. Forebays are multi-beneficial and can be comprised of soil or rock which can serve additional purposes (e.g., fishing jetty). In-lake sediment forebays can reduce sedimentation to the reservoir, capture nutrients, and promote establishment of wetlands as a natural filter. The layout of forebays allows for easier access of equipment to remove sediment when excavation efforts are necessary.

ALUM APPLICATION

An alum application consists of applying a prescribed amount of a chemical complex, typically salts of aluminum, calcium or iron compounds, within a lake to bind with soluble phosphorus and make it unavailable for biological uptake by algae. Aluminum sulfate (alum) is frequently used because it retains its phosphorus-sorbing ability over a relatively wide range of environmental conditions. This allows for the control of algal blooms by reducing the availability of phosphorus that fuels the growth of algae.

PHOSPHORUS PRECIPITATION AND INACTIVATION

Similar to an in-lake alum application phosphorus precipitation and inactivation are techniques used to control algal blooms by reducing the availability of phosphorus that fuels the growth of algae.

Phosphorus precipitation uses a relatively low dose of alum to provide temporary control of algal abundance in the water column until the phosphorus supply is replenished.

Phosphorus precipitation can also be used on streams entering a lake by injecting liquid alum on a flow-weighted basis during rain events. Alum-drip systems have resulted in immediate and substantial improvements in water quality to many lakes across the U.S. The use of an alum-drip system is a potential alternative to be used in conjunction with watershed conservation practices, structural practices such as in-lake forebays, and detention structures.

LAKE AERATION

Lake aeration can be accomplished by pumping oxygen (or air) into the deep, often nutrient-enriched, oxygen-depleted layer that forms in deeper lakes called the hypolimnion. The goal of hypolimnetic aeration is to maintain oxygen in this layer to limit phosphorus release from sediments without causing the water layers to mix (destratify).

SHORELINE STABILIZATION

As reservoirs age, they lose depth due to sediment deposition from the watershed. Shoreline/bank erosion processes can add additional sediment and pollutants to the reservoir while negatively affecting the depth and habitat diversity of shorelines. Physical factors, such as bank height, prevailing winds, fetch, and the amount of vegetation on the banks and in the water, can dictate the extent of shoreline erosion. Bank stabilization practices should be recommended based on a reconnaissance survey of each waterbody. A combination of rip rap (hard armor) and tall grass management or tall grass buffers are common for stabilization of shoreline. Stable vegetated shorelines have increased capacity to attenuate pollutants. Operation and maintenance changes can also support a more stable shoreline by limiting mowing and allowing a healthy stand of vegetation to support the banks along shorelines.

FISH RENOVATION

Fisheries renovation and the restoration and enhancement of in-lake fish habitat can help decrease sediment and nutrient re-suspension and restore healthy ecosystem functions, including riparian and littoral vegetation. A focus of fishery renovation oftentimes involves removing rough fish, such as common carp which stir up and suspend bottom sediments in the water column. Potential in-lake restoration components might include shoreline stabilization, shoals, scallops, spawning beds, etc. Because each lake is unique, the most appropriate combinations of habitat improvement techniques should be employed.

AQUATIC HABITAT DEVELOPMENT

Aquatic habitat restoration includes improving the conditions or enhancing stream ecology to support desired fish and other aquatic species. Actions vary depending upon the goals, but may include increasing overhanging vegetation, decreasing sedimentation, reducing algae growth, providing structural habitat, and removing trash and other man-made products. Aquatic habitat improvement is often a component or result of other interventions, such as streambank stabilization, buffering, and riparian zone renovation. Common structural alternatives include restoring natural flow cycles such as reconnection to an oxbow or floodplain, riverine wetland restoration, native vegetation, and wetland enhancement.

1.07 IN-WETLAND PRACTICES

CONSTRUCTED WETLAND

A constructed wetland is an artificial wetland created for the purpose of treating runoff from an anthropogenic source, such as a livestock facility, urban runoff, or agricultural runoff. Designers use the natural processes involving wetland vegetation, soils, and hydrology to improve water quality. Constructed wetlands can enhance existing wetland systems or create a new system.

WETLAND RENOVATION

Wetland enhancements such as enlargement, vegetation or hydrology management, or restoration of a filled in wetland can offer many water quality benefits. Wetlands treat and filter water and remove pollutants such as nutrients, sediments, and bacteria through attenuation, absorption, filtration, exposure to UV light and microbial predators. Secondary benefits of wetland enhancements include aesthetics, wildlife habitat creation, groundwater recharge, and restoration of the ecosystem's natural functionality.

1.08 GROUNDWATER PRACTICES

WELL SEALING

Well sealing, or well decommissioning of a well includes the of filling, sealing, and plugging a water well. This reduces the risk of pollutants and other contaminants from entering a well which is a direct conduit to groundwater.

OWTS EDUCATION

Adoption of new regulations and new design standards for onsite wastewater systems in 2004, offered an opportunity to address this potential source of bacterial and nutrient contamination of streams. The On-site Wastewater System Upgrade practice for Section 319 projects was created to support pumping and inspection of on-site wastewater systems and to replace systems installed before 2004. Education of homeowners is an important component of this practice to ensure the proper maintenance and functioning of systems.

IRRIGATION MANAGEMENT

See above under Cropland practices.

NUTRIENT MANAGEMENT

Nutrient loss can be reduced by implementing general nutrient application guidelines that have been developed for voluntary or regulatory use. A compilation of guidelines recommended in Nebraska and surrounding states can be used to direct voluntary efforts. Developing a plan to manage nutrients in a farm is an important aspect of properly implementing this practice. General fertilizer application guidelines can include:

- Always apply nutrients at agronomic rates
- Maintain soil phosphorus concentrations at peak production levels
- Do not apply nutrients directly to surface water
- Do not apply nutrients to saturated ground
- Do not apply nutrients to ground that is frequently flooded or when flooding is expected
- Do not apply nutrients to frozen or snow covered soils

COVER CROPS

Cover crops are an important tool for promoting healthy soils. They are designed to absorb excess nutrients after crop harvest and to prevent erosion when the field would otherwise be bare soil. A cover crop is not typically harvested, but is grown to benefit the topsoil and or other crops; however, certain cover crop varieties to have additional benefits as forage crops. If the length of the growing season permits, however, it can be harvested prior to planting a summer crop. Crops such as cereal rye, oats, sweet clover, winter barley, and winter wheat are planted to temporarily protect the soil from wind and water erosion during times when cropland is not adequately protected.

1.09 CONSERVATION PRACTICE FACILITATION

CONSERVATION CONSULTANT

Structural conservation practices generally are easily understood and permanently maintained by land managers. Adoption of management practices, on the other hand, may require learning and applying new skills and developing confidence over several years that management practices will yield the desired benefits. The conservation consultant practice was created as a complement to other management practices to assist land managers in successfully implementing new management practices such as no-till or nutrient and irrigation management. Successful implementation and understanding of conservation management practices by land managers is critical to long-term continuance of those practices.

WATERSHED COORDINATOR

A watershed coordinator can be vital instrument to ensure the success and implementation of a watershed management plan. The coordinator is a person with the day-to-day responsibilities of implementing the plan. Their duties often consist of coordinate with partner organizations the implementation, tracking, and progress reporting of implementation and BMP efforts. Additionally, they provide personal contact with landowners and perform outreach and education activities. They ultimately provide a face and accountability to a watershed project.

CROP PRODUCTION DEFERMENT

Access to agricultural land for installation of structural conservation practices is severely limited by crop production during the growing season (May – October) and by harsh winter conditions (January – February). The Crop Production Deferment practice was created to remove this obstacle to timely implementation of watershed management projects. Producers are paid the average county rental rate to defer crop production on the area delineated for construction (not whole fields) to allow access for summer construction. The area must have sufficient ground cover prior to construction and must be planted to a cover crop immediately after construction to prevent erosion. Acceptable cover may include early maturing crops (e.g., small grains), forage and grass that the producer may harvest prior to construction. The land must be available no later than August 1 for construction to begin. Construction must be completed within the year of deferment. The producer is compensated after construction is completed and the cover crop is planted.